

YARN FEED SYSTEM AND CABLE FOR SAMEFIELD OF THE INVENTION

[0001] The invention relates to a yarn feed system with electrical components and to a cable for making contact with such a yarn feed system.

BACKGROUND OF THE INVENTION

[0002] Yarn feed systems are used in knitting machines or other textile machines for feeding a yarn to a yarn-consuming station, for instance, at a predetermined tension or in a prescribed quantity. The yarn feed systems draw the yarn from a bobbin and keep it in readiness on a drum for consumption by the yarn-consuming machine, or feed it to that machine. Such yarn feed systems are usually secured in relatively large numbers on a suitable mount, such as a so-called machine ring. For that purpose, they have a clamp. Besides the mechanical connection with the textile machine, such yarn feed systems generally also require an electrical connection so that existing electrical components can be connected.

[0003] From German Patent Disclosure DE-OS 21 48 653, a yarn feed system in the form of a yarn storage feeder is known, which has a yarn feed drum that is driven under the control of an electric motor. The drum and the motor are secured to a horizontally extending mount, which on its free end has a jaw-like clamp that is open at the bottom. A hook-like leg of this clamp has a clamping screw, whose axis is oriented transversely to the opening direction of the jaw. On the side facing the clamping screw, there are a plurality of contact pins, which have sharpened tips. The tips serve to pierce the insulation of a cable and make contact with the conductors present in the cable. The cable is a ribbon cable, which is disposed on a carrier or machine ring of rectangular cross section. The contacts, in at least one version, are supported for axial movement so that upon meeting the cable they can still be thrust backward somewhat.

[0004] In making contact, it is important that the contact pins securely meet the conductors that are concealed within the cable. The connection of a yarn feed system to a textile machine must therefore be made with care. The degree of care employed with the

yarn feed system, however, cannot be determined in advance by the manufacturer of the yarn feed system.

### OBJECTS AND SUMMARY OF THE INVENTION

[0005] It is the object of the present invention to provide a yarn feed system which can be properly connected mechanically and electrically to a textile machine in an especially simple, secure way.

[0006] Another object is to provide a cable which can be used with less vulnerability to error in creating a secure connection of the yarn feed system to a textile machine.

[0007] In carrying out the invention, the yarn feed system of the invention has a fastening clamp with contact pins. The contact pins are preferably disposed in stationary fashion. However, in some cases, it can be desirable for the contact pins to be axially movable instead.

[0008] The individual contact pin or contact pins (if there are more than one) have an associated guide element which guides the cable, particularly relative to the transverse direction of the conductor, in the insulation-piercing operation of the contact pins. The guide element preferably is adapted to the contour of the conductor. The conductor is formed for instance by a flat multi-cord cable of rectangular cross section. Accordingly, the guide element then has a jaw of approximately rectangular or even trapezoidal cross section, which corresponds to that of the flat multi-cord cable. The guide element is supported for longitudinal, but not transverse, movement to the contact pins, and as a result in the insulation-piercing operation it holds the cable so firmly that the contact pins securely meet the conductor or conductors of the cable.

[0009] In a first embodiment, the guide element is supported in stationary fashion relative to the main body, and the contact pins are supported for relative axial movement. In the position of repose, the contact pins are retracted far enough that they do not protrude into the interior of the guide element. Thus the cable can be introduced into the guide element by placing the yarn feed system on the machine ring. As the fastening screw is screwed in, first the yarn feed system is fixed as a result. As the fastening screw continues to be screwed

farther in, by a deflection mechanism, the contact pins are thrust forward axially and thus pierce the cable. Alternatively, however, it is also possible for the contact pins to be activated by a separate actuating means, such as a lever, for instance via a cam drive or a separate screw; that is, the contact pins can be made to pierce into the interior, enclosed in jaw-like fashion by the guide element, so as to make electrical contact with the cable.

[0010] Alternatively, the contact pins can be stationary and instead the guide element can be movably disposed. This is particularly applicable to simple, robust embodiments. In that case, the guide element is preferably resiliently supported, and a spring means serves to tense the guide element into a receiving position. In the receiving position, it is located in front of the tips of the contact pins. As a result, it assures that the cable or some other conductor can be introduced into the guide element without becoming caught on the tips of the contact pins and thereby forced out of its desired position. Even if the cable is retained only relatively loosely on the machine ring or support rail of the textile machine, for instance by means of cable binders, correct contacting of the conductors of the cable is possible even if the yarn feed systems are installed somewhat carelessly.

[0011] The contact pins can be connected to various electrical components of the yarn feed system, such as an electrical switch, a sensor, a display device, a motor, a magnet coupling, or the like. The line that belongs to the textile machine and is contacted by the contact pins preferably leads to a central controller of the machine. Individual lines can be connected to a power supply. The lines can be signal lines and/or supply lines.

[0012] The contact pins preferably are insulation-piercing contacts in the form of needles. They can have a round or angular flat cross section, for instance, so that they can drill through a conductor. This is especially practical if the conductor is a flexible lead. It also is possible for the insulation-piercing contacts to be insulation displacement contacts, for instance, in the form of longitudinally slit contact tongues. These tongues pierce a cable insulation and receive the conductor in their slit, thereby contacting it.

[0013] A ribbon cable with one, two or more conductors can be used as the cable. The ribbon cable preferably has a rectangular cross section with rounded corners. In this case, the guide element assures that the contact pins will meet the conductors in the insulation-piercing

operation. In a preferred embodiment of the cable, the cable has recesses on at least one side toward the insulation-piercing contacts, which guide the insulation-piercing contacts and the cable relative to one another in the insulation-piercing operation. The recesses are, for instance, grooves disposed parallel to the conductors which may be on one flat side of the cable or in both opposed flat sides. With respect to a plane oriented radially to the conductor and perpendicular to the flat side, the grooves preferably are disposed centrally to that plane. The grooves may be assigned to some of the conductors or to all of the conductors. In a preferred embodiment of the cable, the cable has two thicker conductors, embodied as flexible leads, which for instance act as supply lines, along with one or more thinner flexible conductors, which serve for instance as a signal line. In that case, the flat sides of the cable are provided with grooves only in the region of the signal lines, and the outer contour of the cable otherwise hardly deviates from a rectangle.

[0014] Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIGURE 1 is a schematic side elevational view of a yarn feed system in accordance with the invention, having a belt drive;

[0016] Fig. 2 is a yarn feed system in accordance with the invention, similar to that shown in Fig. 1, having a motor drive;

[0017] Fig. 3 is an enlarged side elevational view of a clamp for the yarn feed systems shown in the Figs 1 and 2 that mechanically connect the yarn feed system to a textile machine and for simultaneously effecting an electrical connection;

[0018] Fig. 4 is a fragmentary section of the clamp shown in Fig. 3 fitted over a support rail or ring of the textile machine;

[0019] Fig. 5 is a fragmentary section, similar to Fig. 4, showing the clamp upon fastening to the machine ring;

[0020] Fig. 6 is a fragmentary section, similar to Figs. 4 and 5, showing the clamp in a firmly tightened state on the machine with contact pins of the clamp in electrical contacting engagement with an electrical cable of the machine;

[0021] Fig. 7 is an enlarged end view of an alternative embodiment of cable for contacting by the yarn feed system; and

[0022] Fig. 8 is a side view, in partial section, of an alternative embodiment of yarn feed system in accordance with the invention.

[0023] While the invention is susceptible of various modifications and alternative constructions, certain illustrated embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Referring now more particularly to Fig. 1 of the drawings, there is shown an illustrative yarn feed system 1 in accordance with the invention which includes a main body 2 in the form of a mount or housing that is to be secured by a clamp 3 to a support rail or machine ring 4 of a textile machine, such as a knitting machine. The main body 2 projects in cantilevered fashion and supports a yarn feeder 5. In the embodiment of Fig. 1, the yarn feeder includes a yarn feed wheel 6, which is disposed below the main body 2 and supported by a vertical shaft 7 rotatably supported by the main body 2. The shaft, on its upper end above the main body 2, carries one or more pulleys 8, 9, which can be selectively coupled to the shaft 7 via a coupling disk 11. A yarn brake 12 is disposed on the free end of the main body 2, located away from the clamp 3. One or more yarn feeler levers 13, 14 associated with the yarn feed wheel 6 are disposed, for instance, in front of and behind the yarn feed wheel 6 in the yarn travel path and are supported pivotably on the main body 2. These levers are connected to switches 13a, 14a, disposed in the interior of the main body 2, which open or

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close an electrical current circuit when the applicable yarn feeler lever 13 or 14, under the influence of its own weight and/or a reinforcing spring, pivots out of a raised position into a position in which it hangs freely downward. To indicate this state, a signal lamp 16, which is switched on and off by the yarn feeler lever 13 and/or the yarn feeler lever 14, is disposed on an extension 15, preferably extending vertically downward, of the otherwise essentially horizontally disposed main body 2.

**[0025]** For supplying power to the signal lamp 16 and/or for signaling the state of the yarn feeler lever 13 and/or the yarn feeler lever 14, a flat multi-cord cable 17 is disposed on the machine ring 4. This cable is fixed to some extent to the machine ring 4 by cable binders, adhesive tabs, or the like.

**[0026]** The clamp 3 is formed by a jaw that is open at the bottom. The jaw includes a leg 18 which initially extends horizontally in a rectilinear extension of the main body 2 and then, is bent at a right angle, extending vertically downward. The leg 18 defines a jaw 19 whose vertical height is approximately the same as the height of the machine ring 4, and whose horizontal width is greater than the width of the flat multi-cord cable 17 and of the machine ring 4 together. In side view, the jaw 19 has an approximately rectangular contour. For firmly clamping the yarn feed system 1 to the machine ring 4, a clamping screw 21 is used, which engages a horizontally oriented threaded bore of the leg 18. The threaded bore and the clamping screw 21 are disposed approximately centrally in the jaw 19.

**[0027]** The flat multi-cord cable 17 is disposed on the side of the machine ring 4 remote from the clamping screw 21. Contact pins 22, 23, 24, 25 that can be seen in Figs. 3 and 4 are disposed on this side of the jaw 19 and are retained parallel to and spaced apart from one another. The pins 22, 23, 24, 25 which are insulated electrically from one another on the main body 2, extend toward the leg 18 in essentially parallel aligned relation to the clamping screw 21. The contact pins 22-25 preferably are retained in stationary fashion and are disposed vertically one above the other. However, they also can be offset from one another in the longitudinal direction of the flat multi-cord cable 17, that is, perpendicular to the plane of the drawing in Fig. 4, so that the punched holes that are to be formed in the flat multi-cord cable 17 will be spaced farther apart from one another. Each contact pin 22-25 preferably has a length such it does not touch the flat multi-cord cable 17 when the flat multi-cord cable is

introduced with the machine ring 4 into the open jaw 19. On their respective free ends 26, 27, 28, 29, the contact pins 22-25 each have a tip, which is suited for piercing the insulating sheath 31 of the flat multi-cord cable 17. A plurality of conductors 32, 33, 34, 35 are disposed in this sheath 31, each preferably being formed by a flexible copper lead. The vertical spacings of the conductors 32-35 match the vertical spacings of the contact pins 22-25.

**[0028]** The tips 26-29 of the contact pins 22-25 protrude into a jaw-like recess 36, whose size is slightly greater than the cross section of the flat multi-cord cable 17. The tips 26-29, however, do not protrude out of this recess 36. In the region of the contact pins 22-25, a guide element 37 is seated in a vertical chamber or slit area of the recess 36. The guide element 37, preferably made from plastic, has a jaw 41 defined at the top and bottom by two protrusions 38, 39 corresponding in size to the cross section of the flat multi-cord cable 17 and opening toward the clamping screw 21. Between the protrusions 38, 39, the guide element 37 has an essentially plane seating face 42, formed with horizontal bores 43, 44, 45, 46 for receiving the contact pins 22-25, as can be seen particularly from Fig. 1.

**[0029]** The guide element 37, which is shown in Figs. 3-5 in its receiving position is supported on the end of an integrally molded spring arm 47 for movement in a longitudinal or axial direction of the contact pins 22-25. As a result, the guide element 37 is movable to the extent that it can be pressed into the slit-like recess in which the contact pins 22-25 are seated with its back 48 approaching a bottom 49 of the recess.

**[0030]** The yarn feed system 1 described thus far is installed on a machine ring 4 as follows:

**[0031]** For installation, the clamping screw 21 is first screwed out of the jaw 19 far enough that the jaw 19 is completely free. In this state, the yarn feed system 1 is placed with its clamp 3 onto the machine ring 4 from above. The flat multi-cord cable 17 is then located opposite the jaw 41 of the guide element 37, as seen in both Fig. 1 and Fig. 4. If the fastening screw 21 is now tightened somewhat, then as shown in Fig. 5, the flat multi-cord cable 17 moves into the jaw 41 of the guide element 37. The guide element 37, guided precisely in the vertical direction by its spring arm 47, receives the flat multi-cord cable 17 between the

protrusions 38 and 39 and corrects its height, if necessary, so that its conductors 32-35 are located precisely at the height of the contact pins 22, 23, 24, 25.

**[0032]** If the fastening screw 21 is now tightened still more, then the flat multi-cord cable 17 and the guide element 37, as shown in Fig. 6, are thrust onto the contact pins 22-25. While the guide element 37 moves into the recess surrounding the contact pins 22-25, the flat multi-cord cable 17 moves into the recess 36, which is defined at the top and bottom by step-like stops 51, 52. The contact pins 22-25 thereby penetrate the sheath 31 of the flat multi-cord cable 17 and pierce the conductors 32-35, as shown in Fig. 6. In the process, the machine ring 4 is urged against the stops 51-52, whose seating faces are located in the same plane, which results in secure mechanical fastening of the yarn feed system 1.

**[0033]** A modified embodiment of the yarn feed system is shown in Fig. 2, in which the drive of the yarn feeder 5 is effected by means of a motor 53. The motor is seated on the main body 2 at the top and replaces the pulleys 8, 9 of Fig. 1. The motor 53 may be controlled, for instance, by the yarn tension sensors on the yarn feed system 1. For supplying energy to the motor 53, a flat multi-cord cable 17 on the machine ring 4 again is used, whose clamping and electrical contacting is effected as described above and shown in Figs. 3-6.

**[0034]** In Fig. 7, a modified embodiment of a flat multi-cord cable 54 is shown. The flat multi-cord cable 54 has an insulating sheath 31, whose cross section has an approximately rectangular outline. A plurality of cores, for instance six cores 55, 56, 57, 58, 59, 60, are accommodated in the sheath 31 which may be flexible copper leads. Each of the cores 55-60 is surrounded by its own insulation 61, 62, 63, 64, 65, 66, which can be in different colors. All the cores 55-60 are disposed in the same vertical plane 67, which is oriented parallel to the flat sides 68, 69 of the flat multi-cord cable 54. While the cores 55, 56, for instance, may serve as energy supply lines and have a larger cross section, the cores 57-60 can serve as signal lines and have a correspondingly smaller cross section. Accordingly, the center-to-center spacings of the cores 57-60 are also less than the center-to-center spacings of the cores 55, 56. The center-to-center spacings of the cores 57-60 may be less than half the thickness of the flat multi-cord cable 54, or in other words less than the spacing in the vertical plane 67 from one of the flat sides 69 and 68. The secure, correct contacting of the cores 57-60 is facilitated, under these circumstances, by grooves 71, 72, 73, 74, 75, and grooves 76, 77, 78

embodied in the flat sides 68 and 69, respectively. At least one of the two flat sides 68, 69 is provided with corresponding grooves. The groove 71 is disposed approximately centrally to a radial plane 79 of the core 57, which is perpendicular to the vertical plane 67. Accordingly, the groove 71 is located at the same height as the core 57. In the same way, the grooves 72, 73, 74 are at the same height as the cores 58, 59, 60, respectively. The grooves 75-78 likewise are located at the same height as the respective cores 57-60.

**[0035]** A flat multi-cord cable 54 of this kind is especially well suited for piercing, both with and without a guide element 37. The grooves 71-74 guide contact pins that perform the piercing. Conversely, if the contact pins come to rest like the teeth of a comb in the grooves 71-74, then the flat multi-cord cable 54 is automatically positioned at the correct height with respect to the contact pins.

**[0036]** Fig. 8 illustrates a further embodiment of a yarn feed system 1. To the extent that it agrees with the yarn feed systems described above, reference is made to the above description and the same reference numerals. The differences from the above description are as follows:

**[0037]** In the yarn feed system of Fig. 8, the guide element 37 is formed with a recessed contour 81 corresponding to the cable in the side wall toward the flat multi-cord cable 17. The contact pins 22, 23, 24, 25 are outside the contour 81 in the position of repose. They are fixedly carried by a carrier 82 in parallel spaced apart relation to one another and are retained in insulated fashion. Via flexible conduction means (a flexible printed circuit board or the like), the contact pins 22, 23, 24, 25 are connected to a further electrical circuit, not shown, or to the motor 53, the signal lamp 16, and/or some other electrical device. The carrier 82 is supported for movement in the axial direction of the contact pins 22, 23, 24, 25 by a guide device 83, which is depicted in Fig. 8 by two sliding guides disposed on the two ends of the carrier 82. Alternatively, resilient ribs or similar means could be used for joining the carrier 82 to the main body 2. For actuation, that is, for causing the contact pins 22, 23, 24, 25 to pierce the flat multi-cord cable 17, a separate drive mechanism is used, which in the present embodiment is formed by a rotatably supported eccentric element 84. The eccentric element 84 is formed by a cam 85, which is connected in a manner fixed against relative rotation to a hand lever or similar actuating device, not otherwise shown. It serves to displace the carrier

82 in the axial direction of the contact pins. An appropriate spring means may be used for pre-stressing the carrier 82 into its retracted position, shown in Fig. 8, in which the contact pins 22, 23, 24, 25 do not enter into the jaw 41. However, if the cam 85 is pivoted, this causes an axial displacement of the carrier 32, as a result of which the contact pins 22, 23, 24, 25 do move into the jaw 41.

**[0038]** The yarn feed system 1 of Fig. 8 is used as follows:

**[0039]** If it is to be installed on the machine ring 4, as shown in Fig. 8, the carrier 82 is in the retracted position so that the jaw 41 is free. Now the fastening screw 42 is tightened, as a result of which the yarn feed system 1 is firmly clamped to the machine ring 4. The flat multi-cord cable 17 rests in the jaw 41 without yet being contacted. By a rotation of the cam 85, the contact pins 22, 23, 24, 25 are displaced axially so that they penetrate the flat multi-cord cable 17 and contact its conductors 32, 33, 34, 35. Either by its shaping or by means of an appropriate separate detent or locking device, the cam 85 remains in this position. However, it is also possible to dispense with such locking and to rely on the fact that the contact pins 22, 23, 24, 25 that have been made to pierce the flat multi-cord cable 17 will remain in place by frictional engagement.

**[0040]** Hence, in the embodiment of Fig. 8, an actuating device is provided that moves the carrier 82 toward the flat multi-cord cable 17; retraction is either not intended, or is effected by a spring means. Alternatively, it is possible to provide an actuating device that acts in both pushing and pulling fashion, such as a toggle lever drive, threaded drive, sliding block, or the like.

**[0041]** From the foregoing, it can be seen that the yarn feed system 1 of the invention has a clamp 3 for fastening on a machine ring 4. Contact pins are disposed on the clamp 3 and serve the purpose of piercing the insulation of a flat multi-cord cable 17 retained on the machine ring 4. For positionally correct orientation of the flat multi-cord cable 17 before and during the insulation- piercing operation, a guide element 37 is used, which is supported movably on or at the clamp. In the vertical direction, it is preferably retained by a spring arm 49. On its flanks, the flat multi-cord cable 17 preferably has grooves, which can likewise serve to orient the flat multi- cord cable positionally correctly before and during the

insulation-piercing operation. The tips of the contact pins are located in the grooves and thereby bring about the alignment of the flat multi-cord cable 17 or 54.